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Evaluation and correlation of neck masses by multidetector computed Tomography and Ultrasonography

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ABSTRACT

Neck is a conical space that is situated between the base of skull up to the thoracic inlet. It is divided into suprahyoid and infrahyoid part by the hyoid bone. With the advent of cross sectional imaging neck spaces has come into picture. A radiological study of the spectrum of possible neck lesions can largely help the clinicians in diagnosis and prognosis of a patient presenting with a mass in neck.

Ultrasonographic assessment is considered as primary investigation of choice in neck mass evaluation. CT is the modality of choice for evaluating neck masses.

60 patients with clinically palpable neck masses were evaluated using Ultrasonography and CECT and the masses were characterized based on location, morphological characteristics and enhancement pattern. Histopathological details were noted post follow up to achieve the final diagnosis. The study comprised of nodal and non-nodal masses Out of 60 cases studied, 27 cases (45%) had benign lesions and 33 (55%) cases had malignant lesions. Clinical diagnosis was in agreement with the final diagnosis in 71% cases. Ultrasound made a correct diagnosis in 44 out of 60 cases, having a diagnostic accuracy of 73.33%. CT made a correct diagnosis in 57 out of 60 cases, having a diagnostic accuracy of 95%. Since CT is fast, well tolerated, and readily available CT , it can be used for initial evaluation, preoperative planning, biopsy targeting, and postoperative follow-up and reserve USG as a complimentary imaging modality.

KEYWORDS:

Multi-detector computed tomography, ultrasonography, neck masses, nodal mass, neck pathologies.

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INTRODUCTION

Neck is a conical space that is situated between the base of skull up to the thoracic inlet. It is divided into suprahyoid and infrahyoid part by the hyoid bone. With the advent of cross-sectional imaging neck spaces has come into picture. The neck is divided into 12 spaces by the superficial and deep cervical fascia.

Mass in the neck is a common clinical problem, owing to the complex anatomy of neck. In clinical practice, a neck mass is a very common occurrence. Neck disorders appearing as neck swelling might differ from an etiological, pathological, and prognostic standpoint. Despite a wide range of causes, the most common neck masses are congenital lesions, lymphadenopathy, and benign and malignant neoplasm.

A radiological study of the spectrum of possible neck lesions can largely help the clinicians in diagnosis and prognosis of a patient presenting with a mass in neck. In the past, traditional radiographic tests like as plain radiography, lymphograms, esophagograms, and xerography were utilized to evaluate such lesions. Plain X-ray data are frequently insufficient to outline the scope of the illness process and substantiate a valid diagnosis. The technique of xerography can improve the demonstration of the air-soft tissue interface, but the radiation dose is significant, hence it is no longer employed. Because of the technical challenges in performing procedures such as cervical lymphograms, as well as the huge percentage of false positive cases, patients are spared.

The advent of newer imaging modalities like ultrasound and MDCT has revolutionized the diagnosis of neck masses.

Ultrasound

Ultrasonographic assessment is considered as primary investigation of choice in neck mass evaluation.

DOPPLER- the advent of colordoppler study has added a new spectrum to diagnostic sonography as it is able to demonstrate vascular nature of neck masses.

Computed tomography

It is the modality of choice for evaluating neck masses. Computed tomography is helpful in evaluating neck masses located in nasopharynx, base of skull, larynx, pterygopalatine fossa and other areas of neck which are difficult to be diagnosed by ultrasound.

AIMS AND OBJECTIVES

Aims:

1. To study and evaluate the ultrasonography and multi-detector computed tomography features of different primary and secondary neck masses.
2. Comparison study and correlation of final result obtained by both the modalities. (Ultrasound and computed tomography)
3. To differentiate benign and malignant lesion.

Objectives: -

1. To establish the demographic profile of the neck masses. (Incidence, age and sex distribution)
2. To localize and characterize neck lesion with respect to anatomical delineation, extension to adjacent structure.
3. To identify the location of mass, confirm whether the lesion is solid or cystic and detection of non-palpable mass.

MATERIAL AND METHOD

Source of study-

Data for the study was collected from patients with palpable Neck Masses from a time period of February 2021 to August 2022, attended/referred to MGM MEDICAL HOSPITAL, KAMOTHE, NAVI MUMBAI.

Methodology

A descriptive correlational study was conducted over a period of one and half years on 60 patients with palpable neck masses after informed consent. The referred patients were evaluated with multidetector computed tomography and findings were correlated with ultrasonography findings. The ultrasound has been used as a screening modality. The study involved all the referred patients from OPD, admitted patients and all the walk-in patients qualifying the inclusion criteria.

Computed tomography-

- Patient preparation-prior kidney function test were performed. Patient was kept on empty stomach for 4-6 hours prior to scan. Consent was taken.

- Position- supine with neck mildly hyper extended so that the hard palate was roughly perpendicular to the tabletop. Patient was scanned in quiet breathing and swallowing suspended.
- Machine used- Toshiba 16 slice CT
- Procedure- Axial thick cuts 5x5 mm and thin cuts 1x1mm will be taken from base of skull to the lung apices. Using 1-mm axial slices, multi-planar reconstructions were generated in both the coronal and sagittal planes. To detect bone and cartilage invasion, all images were reconstructed using a bone algorithm.
- Intravenous contrast Omnipaque 350mg% (Iohexol) 70ml will be injected by pressure injector through venous cannula. Flow rate- 4ml/sec.

High resolution ultrasonography and colordoppler imaging (Screening modality)-

- Patient preparation-informed written consent.
- Position-supine
- Machine-Philips HD 15
- Procedure-ultrasound examination of the neck was performed in supine position with hyperextension of patient's neck. Examination was done in longitudinal and transverse planes of the mass. The mass was evaluated in terms of its size, shape, consistency, echogenicity, internal architecture, septations within, calcification and necrosis within. Doppler study was undertaken to evaluate the vascularity of the mass. To maximize Doppler sensitivity, the scanning was done at a slow frame rate with a low pulse repetition frequency, a narrow gate, a low wall filter setting, and a high doppler gain setting.

Statistical methods

The statistical analysis is done using statistical analyzing software SPSS24. In univariate analysis frequency distribution and percentage were tabulated and represented in Bar and Pia chart. For the comparison of USG and CT findings ROC curve and AUC were used.

Inclusion criteria-

- Patients presenting with a clinically palpable neck mass and underwent CT scan and Ultrasound.
- Patients with neck swelling.
- Patients with symptoms pertaining to neck.
- All patients with suspected neck mass.

Exclusion criteria-

- Patients with contraindication to intravenous administration of contrast medium or hypersensitivity to contrast agent.
- Postoperative patients.
- Trauma patients.
- Patient unwilling for study.

Case 1

Name-xyz

Age/sex -65 years/m

Id-12345

Presenting complaints- patient presented with swelling, pain and fever.

On CT- hypodense collection noted in peritonsillar region predominantly in buccal space and pharyngeal mucosal space showing peripheral enhancement on post contrast study with adjacent space involvement. There is no evidence of necrosis, bony erosion and any lymph node, features are suggestive of inflammatory collection.

On USG- hypoechoic collection noted in buccal space superficially, with no evidence of vascularity within on colour doppler study.

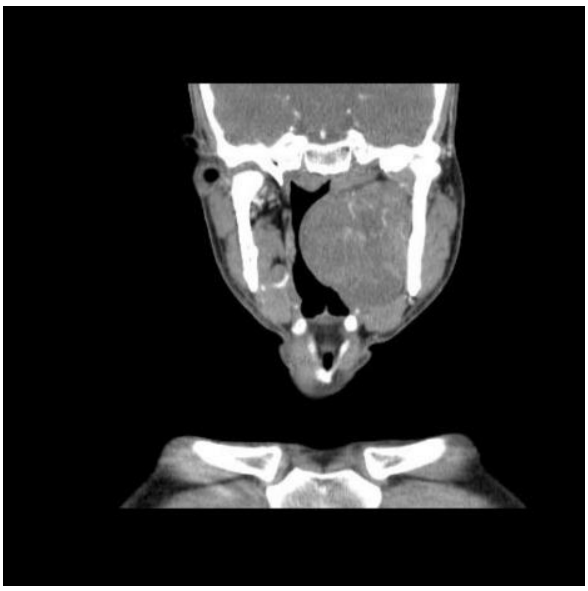

Figure 1a- Cect Neck Coronal Imaging Depicting Collection in Buccal Space and Retropharyngeal Space.

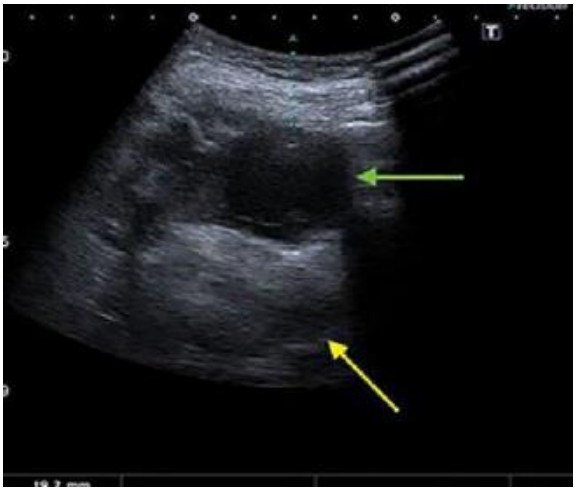

Figure 1b-Usg Depicting Hypodense Collection.

Case 2

Name- abc

Age-45years/m

Id-12345

Presenting complaints - swelling in buccal region.

On CT - heterodense lesion with post contrast enhancement is noted in right cheek on puffed cheek manoeuvre involving right buccal space with evidence of lymph nodes in level ib. Features suggestive of gingivo-buccal carcinoma.

On USG- the lesion was not appreciated.

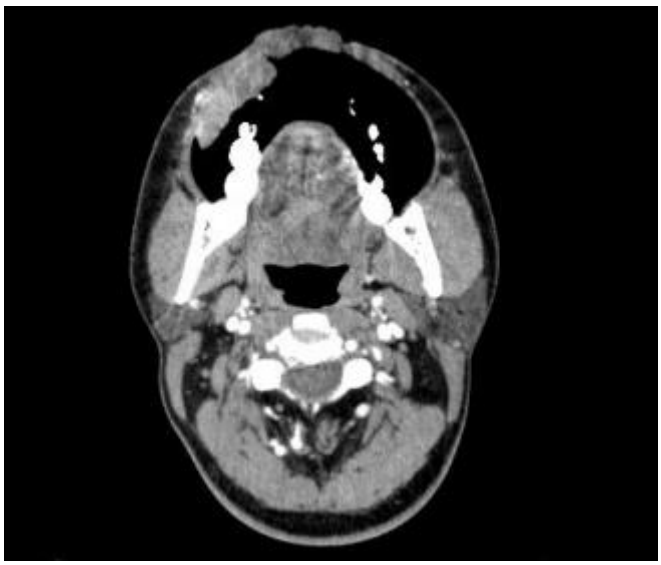

Figure 2a-Axial Cect of Neck Depicting Gingivobuccal Carcinoma.

Case 3

Name-qrs

Age/sex-69years/male

Id-12345

Presenting complaints- swelllingamd dysphagia.

On CT- bilateral thyroid gland is enlarged ,heterodense and enhancing on post contrast study. Multiple cystic areas with specs of calcification are noted within the mass lesion. The lesion seems to be spreading in retrosternal space with evidence of lymph node in bilateral ii, III, IV level. Post FNAC it was diagnosed as thyroid papillary carcinoma.

On USG- bilateral thyroid gland is enlarged, with irregular borders with evidence of vascularity on colour doppler study. The mass lesion appears heteroechoic on ultrasound with solid cystic consistency. The lesion seems to be spreading in retrosternal space with evidence of lymph node in bilateral II, III, IV level.

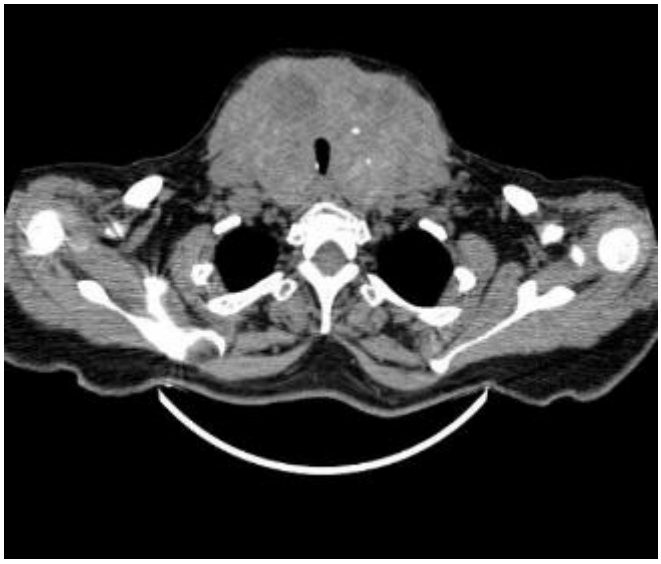

Figure 3a-Axial Cect of Neck Depicting Thyroid Malignancy.

Figure 3b -Ultrasound Depicting Heteroechoic Bilateral Bulky Thyroid.

Case 4

Name-lmn

Age/sex-65 years /female

Id-67897

Presenting complaints- dysphagia and swelling.

ON CT- thyroid gland appears bulky, homogenously hypodense with substernal extension. No evidence of lymph node.

ON USG- bilateral bulky thyroid gland with heteroechoicechotexture. The gland shows increased vascularity on colour doppler study with few hyperechoic nodules within the gland with comet tail artifact.

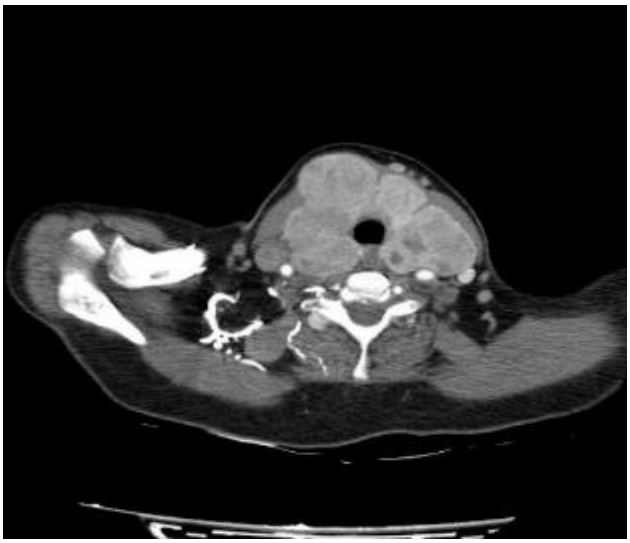

Figure 4a-Axial Ct Scan of Multinodular Goitre

Figure 4b -Ultrasound of Multinodular Goitre

Case 5

NAME-EFG

AGE/SEX-30 YEARS/FEMALE

ID-23456

PRESENTING COMPLAINTS – Past history of pulmonary tuberculosis, presenting with swelling, discharging sinus, fever, weight loss.

ON CT- multiple matted hypodense. necrotic lymph nodes enhancing peripherally on post contrast study noted in level II, III, IV with evidence of peripherally enhancing hypodense collection in level IV on right. Features are in favour of tuberculous cervical lymphadenitis with abscess formation.

ON USG- multiple matted necrotic lymph nodes noted in level II, III, IV with hypoechoic collection at level IV suggestive of cold abscess.

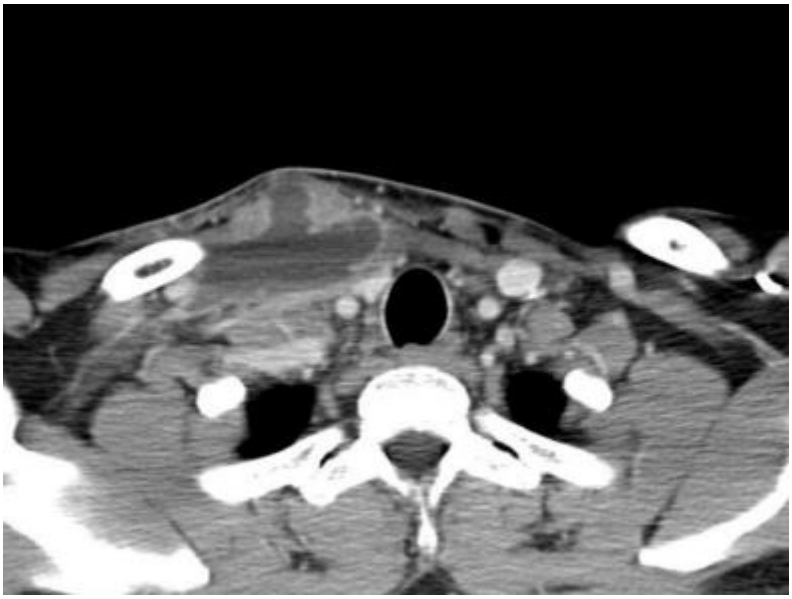

Figure 5a-Axial Cect of Cervical Tuberculous Adenopathy With Abscess Formation.

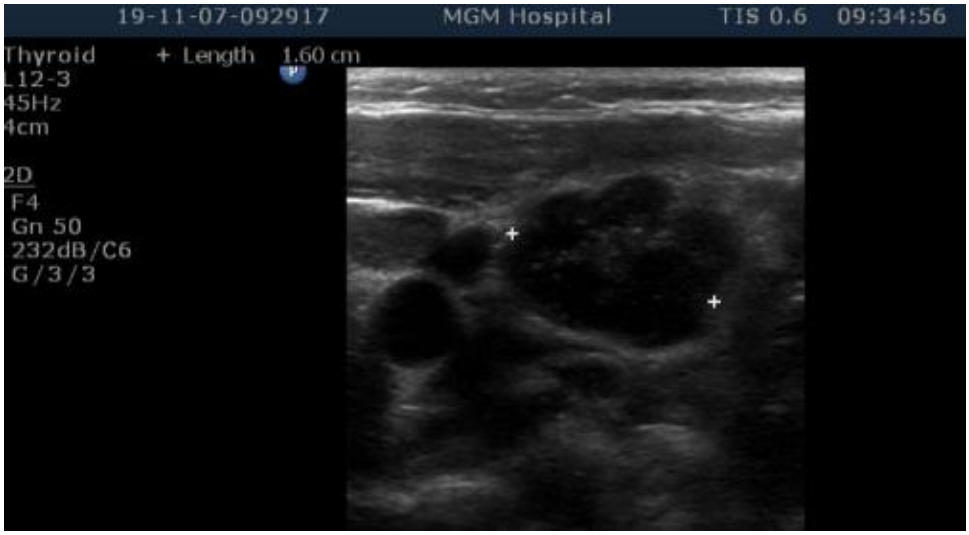

Figure 5b- Ultrasound Depicting Conglomerated Necrotic Lymph Node.

OBSERVATION AND RESULTS

The study was conducted in the Department of Radiodiagnosis, M.G.M medical college and hospital, Navi Mumbai. A total of 60 patients with palpable neck masses were included in our study.

Age distribution

Table No. 1: "Age distribution in study participants"

Age Group	No. Of Cases	Percentage
< = 20 Yrs 5	5	8.3%
21 - 30 Yrs	9	15.0%
31 - 40 Yrs	7	11.7%
41 - 50 Yrs	13	21.7%
51 - 60 Yrs	12	20.0%
61 - 70 Yrs	10	16.7%
71 - 80 Yrs	4	6.7%
Grand Total	60	100.0%

- Age of the patients included in the study ranged from 18-61 years and above.
- Maximum numbers of patients were in the age group 41 to 50 years (21.7%).
- Minimum numbers of patients were in the age group 71 to 80 years (6.7%)

Gender distribution

Table No. 2: "Gender distribution"

Gender	No. of Cases
Female	23
Male	37
Total	60

- Out of the 60 patients included in the study, 37 (62%) were males and 23(38%) were females.
- The overall male to female ratio was 1.6:1.

Symptoms and associated comorbidities.

Table No. 3: "Symptoms and associated comorbidities"

Symptoms	No. of Cases	Percentage
Comorbidity Distribution	20	33.3%
Swelling	41	68.3%
Pain	18	30.0%
Weight Loss in Patients	29	48.3%
Fever in Patients	22	36.7%
Nasal Block	4	6.7%
Dysphagia	47	78.3%
Other symptoms/disease	1	1.7%
Past History of Disease	7	11.7%
Family History of disease	6	10.0%

Maximum patients presented with swelling (68.3%) and dysphagia (78.3%). Other symptoms associated are pain, weight loss and fever.

Neck spaces involved

Table No. 4: "Histopathology v/s Neck spaces involved"

HPE	MALIGNANT	BENIGN	Grand Total
ANTERIOR CERVICAL SPACE	4	0	4
SUBMANDIBULAR SPACE	0	18	18
BUCCAL SPACE	1	18	19
CAROTID SPACE	7	4	11
MASSETER SPACE	1	0	1
PARAPHARYNGEAL SPACE	4	3	7
PAROTID SPACE	1	0	1
PHARYNGEAL MUCOSAL SPACE	4	7	11
PREVERTEBRAL SPACE	1	0	1
RETROPHARYNGEAL SPACE	4	1	5
SUBLINGUAL SPACE	4	1	5
POSTERIOR CERVICAL SPACE	1	2	3
VISCERAL SPACE	6	7	13

Maximum malignant cases were noted in submandibular and buccal space. Maximum benign cases were noted in carotid and visceral space.

Table No. 5: "Lymph node distribution"

Lymph node (necrotic and non-necrotic)	No. Of cases	Percentage
Absent	09	15%
Necrotic	29	28%
Non necrotic	22	37%
Grand total	60	100%

Table No. 6: "Benign v/s Malignant"

HPE (BENIGN /MALIGNANT)	No. Of Cases	Percentage
MALIGNANT	27	45%
BENIGN	33	55%
Grand Total	60	100%

Table No. 7: "Descriptive statistics"

CT * USG Cross tabulation		USG		Total
		Absent	Present	
CT	Absent	2	1	3
	Present	14	43	57
Total		16	44	60

Sensitivity	97.7%
Specificity	87.5%
PPV	77.2%
NPV	12.5%

DISCUSSION

60 patients with clinically palpable neck masses were evaluated using Ultrasonography and CECT and the masses were characterized based on location, morphological characteristics and enhancement pattern. The extent was outlined in terms of involvement of adjacent structures, vessels and lymphadenopathy. Histopathological details were noted post follow up to achieve the final diagnosis.

Maximum number of patients was in the age group 46 to 60 years (28.33%). The overall male to female ratio was 1.6:1.

The study comprised of nodal and non-nodal masses Out of 60 cases studied, 27 cases (45%) had malignant lesions and 33 (55%) cases had benign lesions.Clinical diagnosis was in agreement with the final diagnosis in 71% cases.

Ultrasound made a correct diagnosis in 44 out of 60 cases, having a diagnostic accuracy of 73.33%. CT made a correct diagnosis in 57 out of 60 cases, having a diagnostic accuracy of 95%. Ultrasound and CT together made a correct diagnosis in 43 out of 60 cases, having a diagnostic accuracy of 71%.

A study done by Otto RA et al states that most of the benign lesions of neck occur in pediatric and young adults' group and most of the malignant conditions occur in the elderly.
In another study done by Ravimerhotra et al (2005) showed that the prevalence of head and neck malignancy was highest in patients belonging to the 50-59 years age group.

The most common space involved in the present study was submandibular and buccal space. This could be attributed to the metastatic pathogenesis in this space and higher incidence of buccal carcinomas in the present study.

Nodal masses

Nodal masses were the most common masses encountered and constituted 85% of the total number of cases. Out of 18 benign enlarged lymph nodes 44% were noted in tubercular adenopathy, 16% in multinodular goitre and 11% in others.

In one series done by Reede et al (1982) also found that the most common neck lesion encountered was lymph-node mass.

We observed 27 cases of metastatic lymphadenopathy. All the nodal masses were Histopathologically proven to be malignant cases of different grades.

On USG metastatic node is seen as hypoechoic, round and without echogenic hilus. Intranodal necrosis appears as demarcated echogenic focus and is not continuous with adjacent soft tissues. According to King Ad et al necrosis on CT was defined as a focal area of low attenuation with or without a surrounding rim of enhancement. We used the same criteria to determine necrosis. Necrosis was seen on both USG and CT in 28 cases.

Evaluation of primary lesion

In out 11 of the 33 cases oropharynx was the primary site, out of which 6 cases were gingiva-buccal mucosa carcinoma, 2 were tongue malignancy and 3 were squamous cell carcinoma. The extent of the lesions was defined and any additional findings like bone erosion, prevertebral muscle invasion and involvement of adjacent spaces were noted. In 3 cases larynx was the primary site. The lesions show trans-glottic spread with invasion of the thyroid cartilage. In 1 case the primary site could not be delineated.

In another study by HasanAltumbabic et al (2008) laryngeal cancers were most common (26.1%) followed by cancers of oro-pharyngeal region. And in another study done by M. Whyte et al (1989) the most common lesion is parapharyngeal space was salivary gland malignancy followed by squamous cell carcinoma metastasis and developmental lesions. In their study they could differentiate the Paragangliomas and schwannomas based on enhancement patterns.

Lymphoma

1 case was diagnosed as Non-Hodgkin's lymphoma. The case showed multiple lymph nodes involving multiple levels on USG and CT and on CT the lymph nodes were homogenously enhancing.

Tubercular adenopathy

14 case of tubercular adenopathy were diagnosed. On USG and CT, the tubercular lymph nodes had the appearance of bilateral conglomerate nodal mass with rim enhancement (on CT) and majority showed preservation of fascial planes around them.

Non-nodal masses

Non-nodal masses constituted approximately 15% of the lesions and included salivary gland lesions (33.33%), masses of developmental origin (10.0%), masses of neurogenic (3.33%), vascular (3.33%), mesenchymal origin (3.33%), and inflammatory masses (3.33%). Out of 17 non nodal masses 1 case was malignant (5.87%) and 16 were benign (94.12%).

Salivary gland lesions

2 cases of salivary gland pathology were observed in the present study which comprised of infections (1 case) and ranula (1 case). 1 was a pyogenic parotid abscess. On CT the parotid gland was bulky with a rim enhancing abscess seen. The abscess was drained under ultrasound guidance and patient was given antibiotics.

1 case was diagnosed as a simple ranula and was seen on CT as a well-defined cystic lesion in the sublingual space with thin non enhancing walls.

Masses of developmental origin

1 case was diagnosed as a thyroglossal cyst in a 20-year-old male patient. Ahujaet al[53] in their study have described thyroglossal cysts as midline or near-midline lesion, most commonly occur near the hyoid bone. On CT, the cyst contents usually have a mucoid attenuation.

Masses of vascular origin

One case was diagnosed to have an AV malformation in the neck. Lesion was heterogeneously enhancing in the masseteric space. Patient was given sclerotherapy. Similar imaging findings have been described by Olsen et al.

Inflammatory masses

In our study, 2 cases of cellulitis involving the retropharyngeal space, one case of abscess involving the buccal and pharyngeal mucosal space, 1 case of prevertebral abscess and retro

pharyngeal abscess was diagnosed in a patient presenting with painful swelling with fever, leucocytosis and neutrophilia.

Lazor JB et al (1994) study the false-positive rate was 13.2%, and the false- negative rate was 10.5%. The sensitivity of computed tomography scan for detection of parapharyngeal space or retropharyngeal space abscess was 87.9%.

Holt GR et al (1984) studied deep neck space abscess on 22 patients and identified neck abscess in 6 cases in their study There were no false-positives or false-negatives in the series. In all six cases of abscesses, the CT scan accurately identified the anatomical location of the abscess, allowing a more accurate planning of the surgical approach.

Thyroid masses

In our study there were 8 cases which were considered originating from the thyroid gland. Subsequently 6 cases were diagnosed as multinodular colloid goitre and 2 case was proven to be malignant (papillary carcinoma) on FNAC. All patients underwent total thyroidectomy and histopathological examination of the post operative specimen was done.

As advocated by Laurie A Lovneret al, the main role of cross-sectional imaging in thyroid neoplasms is not in the characterization of an intrathyroidal lesion, as there are no imaging findings that are histologically specific. The role of the radiologist is to assess the findings related to a thyroid mass which will influence treatment decisions, including invasion through thyroid capsule and infiltration of adjacent tissues and structures of neck and to identify presence of cervical lymph node metastasis.

2 of papillary carcinoma diagnosed and 6 cases of multinodular goitre on USG and CT which later confirm on FNAC.Shetty SK in their study concluded that there is no CT feature that distinguishes benign from malignant lesions when correlated to sonographic appearance or histopathology.

CONCLUSION

A careful study of imaging findings of a neck tumour combined with a thorough clinical history and physical examination gave a very brief differential diagnosis.

High-resolution ultrasonography and Colour Doppler is a useful technique for evaluating neck masses in individuals of all ages. It is an easy, non-invasive, and low-cost diagnostic technique. It produces precise and predictable outcomes. It can be utilised as a first-line technique for assessing cervical soft tissue masses in a variety of clinical settings has a useful screening modality.

Computed tomography enables precise localization, extent of mass and differentiation of its consistency into solid, cystic or mixed masses. It helps in defining both the osseous and soft tissue extent, hence enables differentiating benign from malignant lesions, which directly influences the surgical technique required for curative excision. The most important advantage lies in its ability to detect bony lesions (erosions and expansion).

Since CT is fast, well tolerated, and readily available, it can be used for initial evaluation, preoperative planning, biopsy targeting, and postoperative follow-up and reserve USG as a complimentary imaging modality.

However, histopathology still remains the gold standard as CT is not 100% accurate.

SUMMARY

In this study 60 patients with clinically palpable neck masses were evaluated using Ultrasonography and CECT and the masses were characterized based on location, morphological characteristics and enhancement pattern. The extent was outlined in terms of involvement of adjacent structures, vessels and lymphadenopathy. Histopathological details were noted post follow up to achieve the final diagnosis.

In our study few of the cases diagnosed were malignant involving the submandibular space and buccal carcinoma being the most common malignancy and tuberculousadenopathy being the most common benign aetiology.

Ultrasound made a correct diagnosis in 44 out of 60 cases, having a diagnostic accuracy of 73.33%. CT made a correct diagnosis in 57 out of 60 cases, having a diagnostic accuracy of 95%. Ultrasound and CT together made a correct diagnosis in 43 out of 60 cases, having a diagnostic accuracy of 71%.

Ultrasound in conjunction with CT scan is useful in diagnosing and planning the management of the lesions. Ultrasound will always be the primary modality of imaging in all sorts of lesions.

Computed tomography is the modality of choice for evaluating neck masses. Computed tomography is helpful in evaluating neck masses located in nasopharynx, base of skull, larynx, pterygopalatine fossa and other areas of neck which are difficult to be diagnosed by ultrasound. It enables precise localization, extent of mass and differentiation of its consistency into solid, cystic or mixed masses. It helps in defining both the osseous and soft tissue extent, hence enables differentiating benign from malignant lesions.

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